

ELECTRICAL APPRENTICESHIP CURRICULUM OUTLINE FY2012 YEAR 1

Electrical Training: 162 hours

First Semester & Yearly Final Exams: 6 hours

Total Hours: 168 hours

Each of the following subjects may take more or less time than is shown but a minimum of 144 hours is required. The instructor should concentrate on the student achieving the basic objectives stated. The math and theory portion should not be hurried as this is foundational for the next four years.

Recommended Textbooks for the PTE Schools:

Delmar's Standard Textbook of Electricity

National Electrical Code (NEC)

Illustrated Guide to the National Electrical Code

Ugly's Electrical Safety and 70E

Ugly's Electrical Reference

Introduction to Electrical Work: Safety

General Safety Rules

On-The-Job Safety

Objectives: 3 hours

At the completion of this lesson the student should be able to:

- State basic on-the-job safety rules
- Explain what a material safety data sheet (MSDS) is and its requirements.
- Explain safety procedures for trenches
- Explain safety for confined space
- Explain lockout and tagout
- Explain protective clothing to include eye and hearing protection
- Explain the use of a safety harness
- Explain safety for ladders and scaffolds
- State the purpose of arc-fault and ground-fault circuit interrupters

Electrical Theory: Atomic Structure, Electrical Qualities, and Ohm's Law.

Objectives: 9 hours

At the completion of this lesson the student should be able to:

- Explain the structure of the atom
- Explain electron flow
- State the difference between insulators and semiconductors
- Explain the basic methods of producing electricity
- Describe electrical effects such as magnetism, light, and heat.
- Define a coulomb
- Define an ampere
- Define an ohm
- Define an watt
- Calculate different electrical values using Ohm's law.
- Select the proper Ohm's law formula from a chart.

Static Electricity and Magnetism, and Resistors

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Discuss the nature of static electricity
- Discuss lightning protection
- Give examples of both nuisance and useful static charges
- Discuss the properties of permanent magnets
- Discuss the operation of electromagnets
- Determine the polarity of an electromagnet when the direction of the current is known
- Determine the resistance of a resistor using the color code or an ohmmeter
- Determine whether a resistor is operating within its power rating

Series Circuits

Objectives: 9 hours

At the completion of this lesson the student should be able to:

- Discuss the properties of series circuits

- List three rules for solving electrical values of series circuits
- Calculate values of voltage, current, resistance, and power for series circuits

Parallel Circuits

Objectives: 9 hours

At the completion of this lesson the student should be able to:

- Discuss the characteristics of parallel circuits
- State three rules for solving electrical values of parallel circuits
- Solve the missing values in a parallel circuit using the three rules and Ohm's law
- Calculate current values using the current divider formula

Combination Circuits

Objectives: 15 hours

At the completion of this lesson the student should be able to:

- Define a combination circuit
- List the rules for parallel circuits
- List the rules for series circuits
- Solve combination circuits using the rules for parallel circuits, rules for series circuits, and Ohm's law

Electrical Testing Equipment

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Use an ohm meter and measure any resistance in electrical equipment or conductor
- Measure voltage between phases and phase to ground
- Take an ampere reading of any load
- Diagram the proper connection of a watt meter
- State the operation characteristics of analog and digital meters
- Recognize the wave form on an oscilloscope

Introduction to the National Electrical Code and Definitions

NEC Articles 90 and 100

Objectives: 9 hours

At the completion of this lesson the student should be able to:

- Understand how the NEC began and its purpose
- Understand how changes to the code evolve
- Be familiar with the terminology, presentation, and format of the NEC
- State the roles of nationally recognized testing laboratories, the National Electrical Manufacturers Association, and the National Fire Protection Association
- Accurately evaluate a location as accessible, readily accessible, or not readily accessible
- Identify equipment classified as appliances
- State the four categories of branch circuits
- State the difference between a continuous load and a non-continuous load
- State the difference between a branch circuit and a feeder
- State the difference between 'grounded' and 'grounding'
- Define what "in sight" means in the NEC

- Give examples of damp, wet, and dry locations using the code book
- Determine which conductors are the neutral conductors
- Define a separately derived system using the NEC

Boxes and Enclosures

References: Objectives to be taught from NEC Articles 312, 314, 382, and other appropriate NEC sections.

Objectives: 9 hours

At the completion of this lesson the student should be able to:

- Determine the cubic inch capacity of boxes when installing conductors # 6 AWG and smaller
- State which items replace volume allowances of conductor fill when calculating box fill
- State how identical switches or receptacles can be mounted side by side in a two gang box can have different cubic-inch volume allowances
- Determine the box size when the number of conductors is known
- Know the minimum conductor length to be left inside a box
- Explain what must be accessible after installation
- State the mounting and supporting provisions for boxes and conduit bodies using the NEC
- Determine the type of box needed for various applications using the NEC
- Calculate for junction box sizing containing #4 AWG and larger conductors using the NEC

Cables

References: Objectives to be taught from NEC Articles 320 through 340 and other appropriate NEC sections.

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- State the distance from the wood framing member a cable can be installed unless a steel plate is installed
- State the requirements for protection of cable in metal framing using the NEC
- State the sealing requirements in fire-resistant-rated construction when electrical penetrations are made
- Identify what cables are permitted in spaces used for environmental air
- Determine the support requirements for MC, AC, and nonmetallic-sheathed cable using the NEC
- Identify the conductors in a cable and use the NEC to state how certain conductors can be re-identified
- Determine underground installation provisions the NEC
- Identify special application cables using the NEC (This is not to be for installation requirements as this is for first year students)

Raceways and Conductors

References: Objectives are based in NEC Sections 110.14, 240.4, 300.19; and NEC Articles 310, 342 through 378, Chapter 9 tables, and other appropriate NEC sections.

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Determine the general provisions for any raceway installation using the NEC
- Determine the type of raceways suited for individual installations
- Determine the support requirements for various raceways using the NEC

- Determine the provisions for nonmetallic and flexible conduit using the NEC
- Successfully calculate the electrical trade size conduit required for any circuit or feeder
- Determine basic conductor properties using the NEC
- Show conductor temperature limitations
- Determine the provisions for conductors connected in parallel
- Apply conductor ampacity correction factors to include continuous loads.

General Provisions for One-Family Dwellings

References: Objectives are based in NEC Articles 210, 250, 314, 402, 404, 406, 410, 422, and other appropriate NEC sections.

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Calculate the minimum number of 15 and 20 amp branch circuits in a one-family dwelling
- Determine the requirements for single receptacles on individual branch circuits
- Determine the branch-circuit ratings allowed for general-purpose receptacles
- Demonstrate the layout of general-purpose receptacles in a dwelling
- Determine the receptacle rating allowed on various size branch circuits using the NEC
- Determine the requirements for wet bar receptacles using the NEC
- Determine the requirements for lighting and switching using the NEC
- Determine how and when to use the white conductor as an ungrounded conductor
- Determine any general requirement for boxes using the NEC
- Determine any illumination requirement for entrances and exits
- Determine the allowable use of vegetation such as trees for the mounting of outlets.

Specific Provisions for One-Family Dwellings

References: Objectives are based in NEC Articles 210, 410, 422, and other appropriate NEC sections.

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Determine the required ampere rating for any receptacle or branch circuit in kitchens, pantries, dining rooms, breakfast rooms, and similar locations
- Determine the requirements for counter top receptacle placement using the NEC.
- State the minimum number of utility circuits required and their application
- Determine the requirements for appliances both cord and plug and permanently connected
- Calculate the load requirements for appliance branch circuits
- State the specific provisions for GFCI placement
- Identify luminaries permitted in closets and its placement
- Define a bathroom by the NEC and discuss the circuit requirements for receptacles, lights and fans
- Determine the requirements for receptacles and lighting in attached garages, detached garages, and basements
- Determine the requirements for laundry rooms to include the clothes dryer
- Determine the lighting and receptacle requirements for attic, crawl space, and HVAC equipment.

Load Calculations for One-Family Dwellings

References: Objectives are based in NEC Articles 210, 220, 310 and other appropriate NEC sections.

Objectives: 12 hours

At the completion of this lesson the student should be able to:

- Calculate the general lighting for a one-family dwelling
- Specify the volt-amp requirements for small appliance and laundry branch circuits
- Apply demand factors to the general lighting load
- Apply demand factors to fastened-in-place appliances
- Calculate feeder demand loads for household clothes dryers
- Calculate feeder demand loads for household cooking equipment
- Calculate feeder demand loads for heating and air conditioning
- Calculate a one-family dwelling or feeder using the standard method
- Calculate a one-family dwelling or feeder using the optional method
- Size service and feeder conductors
- Calculate the minimum size neutral conductor
- Select the proper grounding electrode conductor

Services and Electrical Equipment for One Family Dwellings

References: Objectives are based in NEC Articles 110, 225, 230, 240, 250, 300, 310 and other appropriate NEC sections.

Objectives: 9 hours

At the completion of this lesson the student should be able to:

- Determine adequate strength for a mast supporting service-drop conductors
- Explain the use of service-entrance cable, though it is used little in the western U.S.
- Define a service lateral and briefly explain its provisions
- Determine clearances for service and outside overhead wiring
- Determine work space required for electrical equipment, services, and panels
- Define a panelboard, an enclosure, and a cutout box
- Determine the proper application and use of circuit breakers and fuses using the NEC
- Determine the appropriate table (310.15(B)(7) or 310.15(B)(16) for conductor sizing
- Size the grounding electrode conductor, equipment grounding conductor, main bonding jumper, bonding jumpers on the supply side or load side of the main breaker or fuse on any one-family dwelling service
- Properly install grounded and grounding conductors in subpanels
- Prevent objectionable current flow in grounding conductors and equipment
- Properly install a panelboard in a separate building or structure

Comprehensive Provisions for Multifamily Dwellings

References: Objectives are based in NEC Articles 210, 230, 240, 310, Chapter 9, Tables 8 and 9, and other appropriate NEC sections.

Objectives: 9 hours

At the completion of this lesson the student should be able to:

- Determine when more than one service can be installed on a multifamily building
- Determine the proper number of disconnects allowed on a service
- Determine proper access to a units disconnecting means by any occupant

- Properly install the grounding electrode conductors to the grounding electrode
- Determine the proper use of tables 310.15(B)(7) and 310.15(B)(16) when sizing service and feeder conductors
- Determine outdoor receptacle placement
- Calculate voltage-drop (The use of Ugly's Electrical Reference is strongly recommend)

Hand Bending Conduit

References: www.mikeholt.com/documents/freestuff/BendingRoundRaceways.pdf or publications from manufactures such as Ideal, Greenlee, etc.

Objectives: 3 hours

At the completion of this lesson the student should be able to:

- Properly use a hand bender
- Create a 90 degree the correct length using a hand bender
- Bend an offset for any measurement
- Create a saddle bend
- Have the confidence to begin running conduit under supervision on the job

Commercial Locations: General Provisions

References: Objectives are based in NEC Articles 210, 220, 310, 410, 600, and other appropriate NEC sections.

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Compare receptacle placement with that of one-family dwellings to show the difference
- Determine the receptacle requirements in a commercial bathroom
- Determine the sign outlet requirements in a commercial installation
- Determine the branch circuit requirements for motors and air conditioning
- Determine the volt-amp ratings for receptacles (single, duplex, quad, etc.)
- Determine the maximum number of receptacles permitted on a 15 amp and 20 amp circuit
- Apply accessibility requirements to receptacles in guest rooms of hotels and motels
- Determine showcase and show window requirements using the NEC
- Calculate general lighting load based on square-foot area
- Determine the provisions for florescent, HID, recessed, and track lighting provisions
- Determine the proper use and restrictions when using luminaries as raceways
- Determine metal pole conductor access requirements

Commercial Locations: Services, Feeders and Provisions

References: Objectives are based in NEC Articles 110, 250, 368, 408, and other appropriate NEC sections.

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Determine minimum vertical clearances for each installation using the NEC
- Apply dedicated space requirements to electrical equipment to include the area that is to be clear of foreign systems unless protection is provided
- Determine the working clearances of any installation using the NEC
- Properly install both grounding and grounded conductors on the line side and load side of the service supply conductors

- Determine the conditions that require ground-fault protection of equipment
- Recognize a transformer and a generator separately derived systems
- Properly ground and bond a separately derived system
- Recognize and explain the use of busways

The following areas of study are to be considered introductory to first year students and should be treated as such.

Hazardous Locations: Overview

References: Objectives are based in NEC Articles 500 through 516

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Explain what a hazardous location is
- Determine if a classified location is Class I, II or III and if it is Division 1 or 2 using the NEC
- Determine the provisions pertaining to commercial garages and repair and storage facilities using the NEC
- Determine the provisions for buildings in which aircraft are stored and repaired
- Determine the provisions for a motor fuel dispensing facility

Health Care

References: Objectives are based in NEC Articles 500 through 516

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Discuss basic health care terminology
- Determine the grounding and bonding requirements of any health care facility
- Identify patient care areas as general care or critical care and their branch circuit requirements
- Determine the tamper-resistant requirements of pediatric facilities
- Define the two types of systems (equipment and emergency)

Special Occupancies

References: Objectives are based in NEC Articles 500 through 516

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Define “places of assembly” according to the NEC
- Determine manufactured building requirements
- Determine agricultural building requirements
- Determine requirements for mobile home parks and recreational vehicle parks